Research Report

Taxation of alcoholic beverages

Estimation of tax revenue effects in the Netherlands and Europe

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Final Report

Study for SpiritsNL

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Comments

This report reflects the work of the authors and their conclusions based on the available data. As such the content and does not necessarily reflect the opinion of the institutions. All remaining errors remain in the responsibility of the authors. We also want to thank Joep Stassen for valuable feedback on earlier drafts of this report. Simon Loretz was the principle investigator, was responsible for the analysis and therefore, all requests/questions related to this project should be addressed to him. Gregor Zwirn was the project manager and provided input as regards data.

Executive Summary

1. Over the last 20 years, the market for alcoholic beverages in the Netherlands has changed substantially. While sales of spirits and beer fell, the quantity of wine sold increased markedly. In particular, spirits sales experienced a significant decline in the Netherlands: between 1994 and 2013 spirits sales declined by 25 % in volume. The most severe decline in sales among various spirits categories can be observed for Genever.
2. In 2014, the excise duty burden is levied on beer, still wine and spirits amounted to 1,024 million Euros in the Netherlands and excise tax burden on spirits contributed 30 % to the overall revenues. Over the period observed the tax burden for spirits was at approximately three times the level of still wine, beer or intermediate products. This suggests that a higher tax burden has contributed to the relative and absolute decline of spirits sales.
3. A comparison between budgeted and actual spirits excise duty revenues suggests that spirits consumers are more responsive to tax changes than anticipated by policy makers. The sharp increases in spirits excise duty failed to result in a corresponding increase in the spirits excise revenues between 2003 and 2006.
4. We find a precisely estimated full pass-through of excises to prices in 26 European countries. For the Netherlands, the estimated pass-through amounts to 0.46. This would imply that a 10 % excise increase results in a 4.6 % increase in prices. However, due to the small number of observations for the Netherlands, the estimate is not very precise. Full pass-through of excise taxes on prices in the Netherlands is, therefore, also within the range of plausible results.
5. We find, as another intermediate result, that the volumes sold react to the excise tax burden. In the Netherlands, we observe a stronger reaction for spirits and wine, which implies that raising the excise taxes on spirits will further erode the tax base.
6. The direct impact of excise duty increases on excise revenues for different alcoholic beverages in the Netherlands are as follows: A 10% spirits excise duty rate increase is estimated to increase spirits excise duty revenues by 5.6%. A 10% wine excise duty increase is estimated to increase wine excise revenues by 5.9%. A 10% increase in beer excise duty rate increase, is expected to increase beer excise duty revenues by 7.8%. These results are broadly in line with the result for our broader European sample.
7. In reality, consumption/sales of different product types (beer, wine, and spirits) are not independent from each other, and, therefore, the substitution effect is of importance: people may switch from, say, spirits to beer consumption. Now, when allowing for this substitution between different alcoholic beverages, a 10% spirits excise duty rate increase would lead to an even smaller increase in spirits excise duty revenues, namely 4.8%, in the Netherlands. Whereas for wine, the estimated revenues would slightly increase to 6.2% and the estimated revenues for beer would remain the same as in the model that ignores substitution effects: 7.8%. These results suggest that if one intends to primarily increase tax revenues, taxing beer more heavily is more efficient than further increasing tax burden on spirits.
8. Excise duty increases may also lead to cross-border shopping and, therefore, reduce the potential excise revenue collection while increasing the sales and revenues in the neighbouring countries. We find that a 10% spirits excise duty rate increase in the

Netherlands results in a 2.6% increase in spirits excise revenues in Belgium and a 1% increase of excise revenues in Germany. Notice, however, that the reported percentages refer to the entire countries Belgium and Germany, not only the neighbouring regions. Furthermore, since the tax rates in the neighbouring countries did not change much over the period observed, we are unable to separately identify the impact of the neighbouring tax burden on the Dutch excise tax revenues.

Specific simulation findings:

9. We first simulate the scenario where all alcoholic beverages are taxed in a non-discriminatory manner based on their alcohol content in the Netherlands. Aiming to maintain the same total excise revenues, we would obtain the following results for 2015: spirits excise duty rates would decrease by 40% from currently 1,686 Euros per hl of pure alcohol to 1,012 Euros; the duty rate for beer would increase by 30% from 760 Euros per hl of pure alcohol to 987 Euros; and the rate for still wine would increase by 25% from currently 804 Euros per hl of pure alcohol to 1,005 Euros. Our simulation predicts that total excise duty revenues would increase from currently 1,064 million Euros to 1,125 million Euros in 2015. Notice that if the current rates remain unchanged, we predict that the total excise duty revenues for 2015 would increase slightly from 1,064 million Euros in 2014 to 1,103 million Euros in 2015. This alcohol content balanced taxation scenario would slightly increase volumes of spirits sales and decrease beer and wine sales. The total alcohol volume sold in the Netherlands would decrease from 16.5 million hl in 2014 (based on the current tax rates) to 15.4 million hl in 2015, according to our simulation. Note, that all simulation results are based on a small number of observations and therefore have to be seen with some caution. For more detailed simulation results can be found in section 5.1.
10. If we are interested in reducing spirits excise duty rates by 10% to 1,517 Euro per hl of pure alcohol, but maintaining the same total governmental excise revenue, we simulated three possible scenarios. First, we increase both the tax on beer and wine by the same proportion. Second, we increase only the tax burden on wine. And, finally, we increase only the tax burden on beer. Table 9 summarizes the results (see section 5.2). The proportional duty rate increase for beer and wine would lead to rates of 797 and 843 Euro per hl of pure alcohol, respectively. Total governmental revenues would remain the same, but total alcohol volumes sold in the Netherlands would decline slightly to 16.1 million hl, according to our simulation.
11. Finally, we simulated how total excise duty revenues in the Netherlands could be increased by 100 million Euros. First, we investigated by how much the tax rate for each product type (beer, wine, and spirits) would need to be increased in isolation, and, afterwards, we estimated a proportional tax change to obtain the assumed revenue increase (see section 5.3 and table 10). In isolation, a tax rate increase of 49% for spirits, 41% for beer, or 36% for wine would result in the desired revenue outcome. If the burden is split proportionally by spirits, beer, and wine, a 13% increase would be necessary to obtain an extra 100 million Euro excise revenues. However, a proportional split would not change the already unbalanced taxation system in the Netherlands.

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DG TAXUD	Directorate General Taxation and Customs
EU	European Union
hl	hectolitre
IWSR	International Wine and Spirit Research

1. Introduction and background

The markets for alcoholic drinks are changing dramatically in the Netherlands. Using the data from the International Wine and Spirit Research (henceforth IWSR) that collect in-depth information about the wine and spirits market, Figure 1 depicts the trend for the different types of drinks. The most apparent change is the substantial contraction of the market for spirits in the Netherlands shown in the graph as the red line. Over the period 1994 to 2013 the market has contracted by about 25 percent. One potential caveat is the treatment of ready to drinks (alcopops) which saw a strong increase in the early 2000s. However, even if one adds mixed drinks and spirits together, the volume has still contracted – despite a short increase in the early 2000s – by about 12 percent (see purple line in Figure 1). At the same time the volume of the wine market depicted as the green line is growing significantly and is – after a strong increase in the 90s now about 45 percent higher than in 1994. Beer shows a moderate downward trend and the output sold in 2013 was almost 12 percent lower in 2013 than in 1994. It is noteworthy that the time series for the beer market provided by IWSR is discontinuous, that is why we use the values provided by the association of the Dutch brewers for the period between 2008 and 2013.

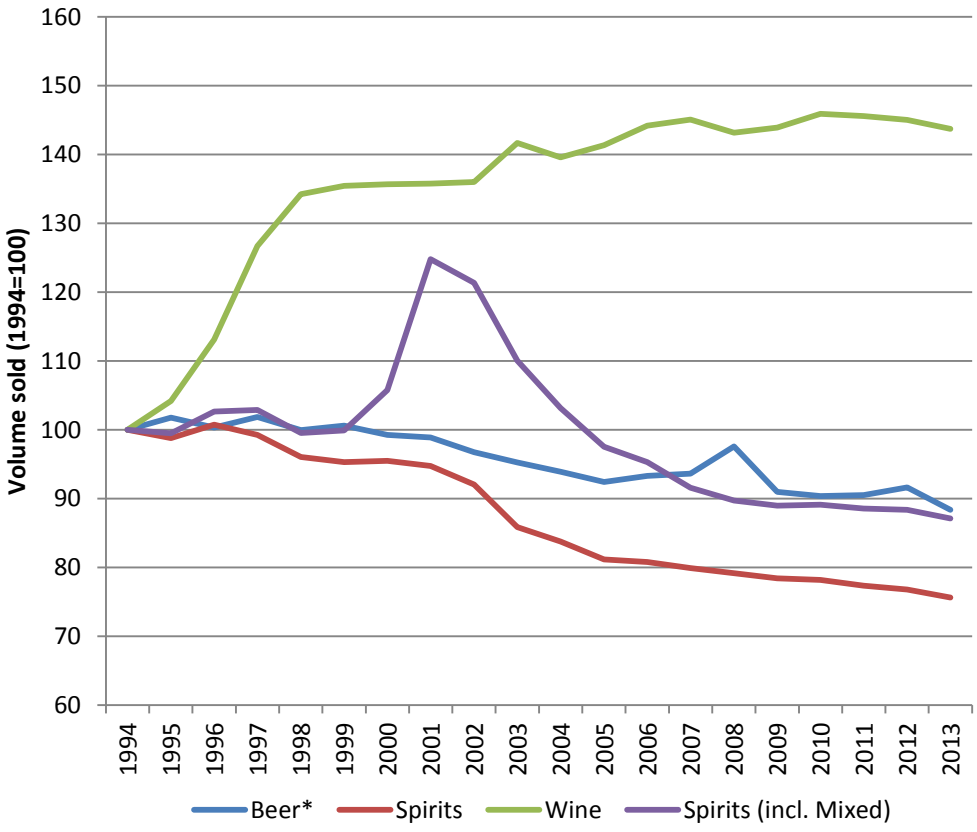

Figure 1: Trend in volume sold alcoholic beverages in the Netherlands, 1994-2013

Source: IWSR & Nederlandse Brouwers/Dutch Brewers for Beer 2008-2013

Table 1 shows the corresponding absolute values. The beer market is by far the largest by volume. The 13.5 million hl in 1995 amounted to a consumption per capita of 85.8 litres of the final product. By 2013 this has declined to a total consumption of roughly 11.7 million hl, corresponding to a per capita consumption of 69.6 litres. For spirits this decline has been even more pronounced with a decline from a total of 841,000 hl in

1995 to 636,000 hl in 2013. In terms of per capita consumption this represents a decline from 5.4 to 3.8 litres of the final product. In contrast the total volume of wine sold in the Netherlands increased from 2.7 million hl in 1994 to 3.9 million hl in 2013. This signifies an increase from 17.6 litres per capita to 23.2 of the final product.

Table 1: Volume sold of different alcoholic beverages, in 1000 hl, 1994-2013

Year	Beer	Mixed Drinks	Spirits	Wine
1994	13,231	0	841	2,716
1995	13,467	6	831	2,829
1996	13,276	16	847	3,072
1997	13,475	30	835	3,441
1998	13,225	29	807	3,646
1999	13,309	39	801	3,679
2000	13,129	86	803	3,686
2001	13,080	252	796	3,688
2002	12,800	246	774	3,694
2003	12,605	203	722	3,848
2004	12,425	163	704	3,791
2005	12,225	138	682	3,839
2006	12,345	122	679	3,916
2007	12,385	98	672	3,940
2008	*12,910*	89	665	3,888
2009	*12,034*	89	659	3,909
2010	*11,956*	92	657	3,963
2011	*11,974*	94	650	3,955
2012	*12,122*	98	646	3,939
2013	*11,691*	96	636	3,904

Notes: The data is from IWSR and is shown in 1,000 hl. The values (in italics) for the beer market for the years 2008 to 2014 are from the Nederlandse Brouwers/Dutch Brewers.

Overall, these trends raise the question, are Dutch people undergoing a change in their preferences for alcoholic drinks and/or might there be a different underlying cause? One aspect which surely has the potential to contribute to the relative decline of spirits is the constantly higher excise tax burden on spirits in comparison to other alcoholic beverages such as wine, beer or other products.

In taxing alcoholic beverages any government tries to achieve two competing goals. First there is the desire to raise tax revenues to provide public services (fiscal reasons). Secondly there is the argument that (excessive) consumption of alcohol has negative effects on consumers and the broader public because it is associated to health problems and damaging behaviours of intoxicated people. This constitutes the second reasoning for the taxation of alcoholic beverages (public health aspects), and has in fact also led the European Union to adopt the Council Directive 92/84/EEC (European Union, 1992b) which stipulates that every Member State has to levy minimum excise taxation on all alcoholic beverages.

For taxation purposes the Council Directive 92/83/ECC (European Union, 1992a) distinguishes between different types of alcoholic drinks. The first broad distinction is between products which contain only alcohol of purely fermented origin, such as beer, still and sparkling wine and other fermented beverages and products which also contain alcohol of not purely fermented origin. The latter includes intermediate products and spirits. One technical distinction in Article 17 of the directive is that all products with an alcohol content exceeding 22 % vol. will fall into the category ethyl alcohol, or spirits, as we refer to it in this study. Due to data constraints and because of the relative importance in the Netherlands we will focus on beer, still wine and spirits in this report.

Interestingly the minimum level of the excise tax varies strongly between different drinks from 0 for wine to 550 Euros per hectolitre of pure alcohol for spirits. This is likely to reflect two completely different aspects. First, it could be due to a strong influence of wine (and beer) producing countries on the legislative process which resulted on a very low minimum tax rate for beer and a zero rate for wine. Second, it could reflect the belief that strong alcohol is much more hazardous and therefore needs to be taxed at a higher rate. Regardless of the original motives for the exact drafting of the directives, unless the minimum rates are binding each Member States still has the above mentioned two competing goals when deciding on the excise duties. It is important to keep in mind that the fiscal motive of raising tax revenues is to some extent competing with the motive to curb excessive consumption. If taxation of alcoholic beverages is successful in reducing the consumption, it will be less successful in generating tax revenues.

Without any background information about the underlying motives of the policy makers it is still interesting to have a closer look at the development of the tax burden on different alcoholic beverages in the Netherlands.

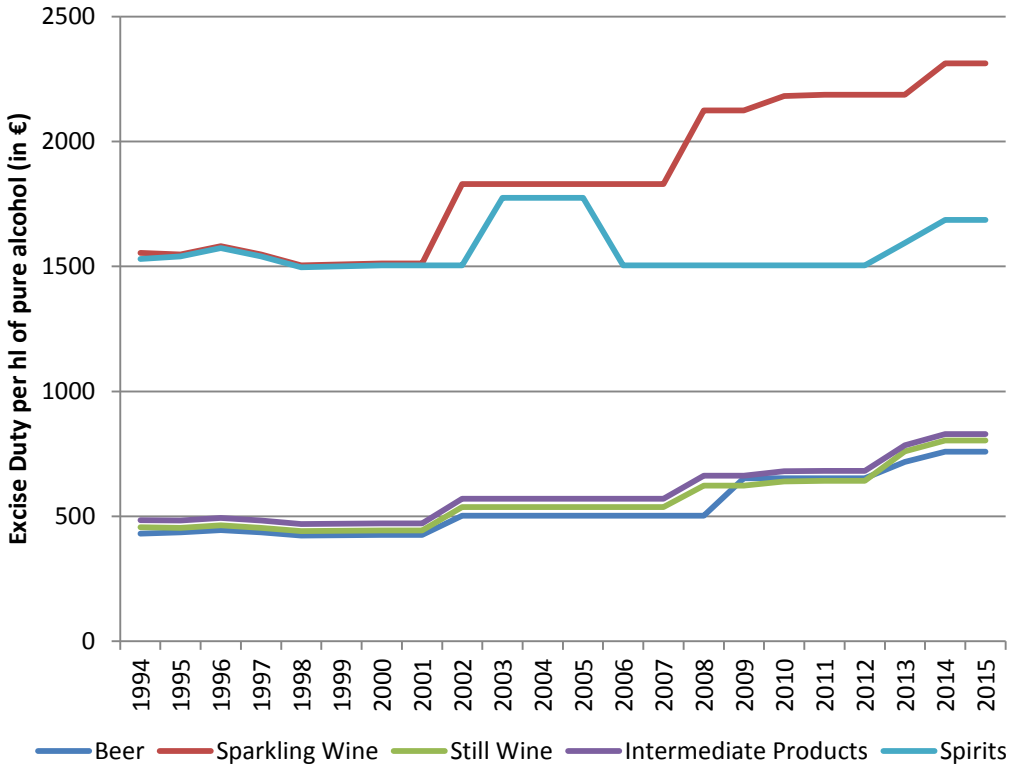

Figure 2: Development of excise taxes on alcoholic beverages in the Netherlands 1994-2015

Figure 2 shows the development of the excise duties for the different types of alcoholic beverages in the Netherlands over the last 20 years. First, it is worth noting that the minimum tax rates set by the European Commission are not binding for the Netherlands since the level of the tax burden is set significantly higher for all types of drinks. In particular sparkling wine and spirits have constantly been taxed at a much higher rate. Over the period observed the tax burden for spirits was at approximately three times the level of still wine, beer or intermediate products. Between 2003 and 2005 spirits were for a short spell taxed at an even higher rate than currently. This relatively high level of spirits excise duty rates in comparison to other beverage types already hints at the fact that the Dutch government is not only pursuing an internalisation of negative effects of alcohol consumption but also and mainly revenue goals. However, if spirits drinks are mainly taxed for fiscal reasons, why are excise duty rates for beer and wine significantly lower? Therefore one key aim of this report will be the analysis of how tax revenues can be raised most efficiently from taxing the consumption of all types of alcoholic beverages.

The consumption of alcoholic beverages is like the consumption of other standard goods reactive to the price of the goods. Therefore increasing the tax burden on alcoholic drinks is likely to reduce the consumption. If the tax burden is only increased on a certain type of alcoholic beverages this is likely to lead to a substitution with other alcoholic drinks. In this case a tax increase may lead to less than expected additional revenues in this particular product category. Given the large increase and subsequent decrease in the tax burden on spirits, it is worth investigating how spirits excise duty revenues have reacted to changes in duty rates and how accurate the government predicted the changes in revenues.

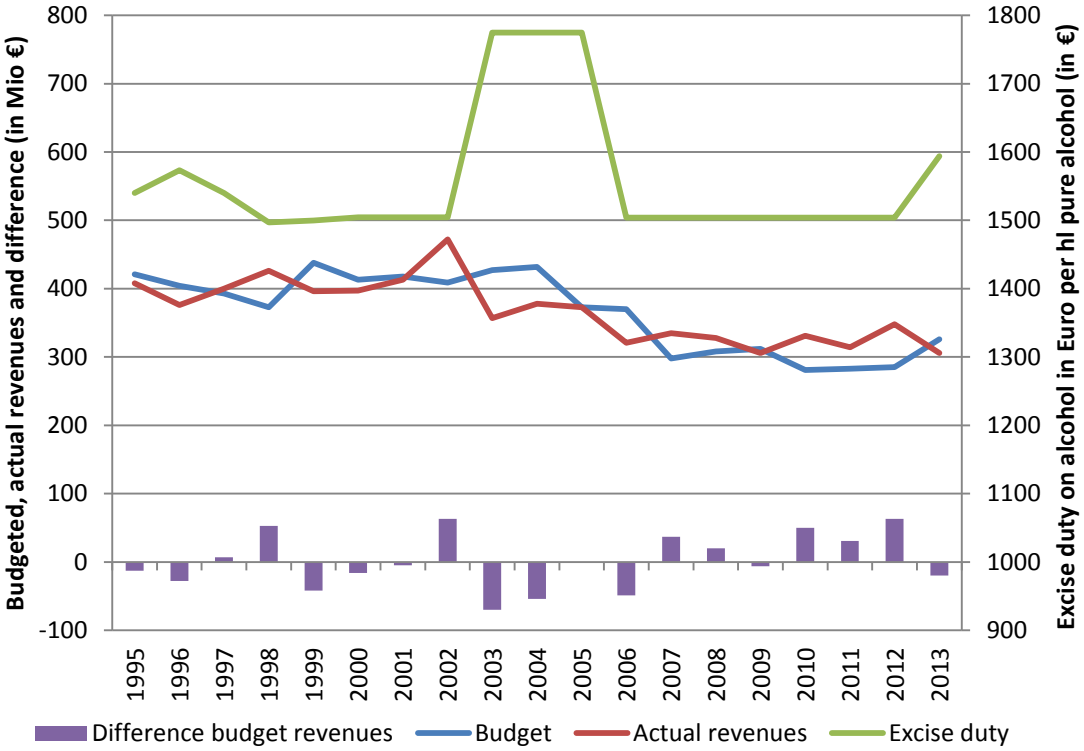

Figure 3: Development excise duty and revenues in the Netherlands, 1995-2013

To this end Figure 3 plots the development of the excise duty (the green line) against the actual revenues (red line) and the budgeted revenues from this duty (blue line). At the bottom of the graph the bars represent the difference, i.e. the error in the revenue forecast.

A few things are clearly visible in Figure 3. First, spirits excise tax revenues are falling over the observed period, which comes as no surprise since the volumes sold are also constantly falling. Second, between 2003 and 2006, when spirits excise duty rates were increased significantly, the sharpest decline in spirits excise duty revenues can be observed. Third, the biggest forecast errors occur just before and after a tax change. This is not surprising as such, but the pattern suggests that the significant tax increase in 2003 resulted in considerable advanced transactions and the reduction in 2005 in delayed transactions. Hence, there seems to be at least anecdotal evidence that consumers in the Netherlands do react significantly to the level of spirits excise taxation. The budgeted spirits excise duty revenues have not adequately taken the responsiveness of consumers into account.

The rest of the study is structured as follows. The next section gives a very brief overview of previous studies which investigate the effects of excise taxation on the price and consumption level of alcoholic beverages. Section 3 describes the sources of the data used in this study. In Section 4, a number of intermediate results are presented. First the price pass through of taxes for different products is estimated. Then the reaction of the volumes sold to changes in taxation is analysed. The effects of tax rate changes on the revenues are estimated both with and without taking into account the substitution between different types of alcoholic beverages. In Section 5 the results from the estimations are used to simulate various changes in the taxation of alcoholic beverages. Finally Section 6 concludes.

2. Previous literature

There is a vast body on literature concerned with taxation of alcoholic beverages and the impact on prices and quantities sold. Hence this short literature review is not aimed at providing a complete picture, but rather an indication of how this study compare to the previously found results. For a very broad and general overview of the issues relating to alcohol and the corresponding literature see also Anderson and Baumberg (2006).

Two large studies by Rand Europe (Rabinovich, et al. 2009 and 2012) analyse the development of the affordability of alcoholic beverages in the European Union and find that mainly due to increases in income alcohol has become more affordable (Rabinovich et al 2009). Rabinovich et al. (2012) explicitly analyses the **pass-through of excise taxes on prices** for six countries and find a great deal of heterogeneity among the countries and beverages. Pass-through rates vary from significantly below unity for Ireland and Finland to strong over-shifting in Slovenia and Latvia. While the authors raise already a number of limitations (endogeneity of tax increases, omission of other factors, use of an average price index) the wide variation in the results can also be due to the econometric approach (regression using first differences) which only exploits the immediate price reactions. There are other academic studies which suggest an over-shifting of excise taxation to price. For example Young and A. Bielinska-Kwapisz (2002) and Kenkel (2005) find evidence for significant over-shifting of excise taxation in the US, respectively Alaska.

Waagenar et al. (2009) review the literature on the **price elasticity of alcohol** and perform a meta-analysis. Using 1003 estimates from 112 studies they find that beer is

with a mean elasticity of -0.46 less responsive to changes in price than wine (- 0.69) and spirits (-0.80). These findings are broadly in line with the results of a previous meta-study by Gallet (2007) who finds a median elasticity for beer of -0.36 and -0.70 for wine and -0.68 for spirits. More recently Ruhm et al. (2012) make a strong claim for the use of micro data from scanners in grocery store and show that the use of average price data could lead to overestimation of the price elasticity. Their analysis correspondingly finds a price elasticity of -0.3 for beer which is at the less elastic end of the results of the previous literature. In short, according to recent meta-analyses, own-price elasticity estimates for different beverage types range from

- -0,27 to -0,46 for beer (Nelson and Gallet's estimates are very close to Fogarty),
- -0,24 to -0,7 for wine (Nelson's estimate is very close to Fogarty, whereas Wagenaar's et al. estimate is closer to Gallet)
- -0,55 to -0,8 for spirits (Gallet's and Fogarty's estimates are at around -0,6).

Among the vast number of studies Leppänen et al (2001) is worth mentioning since it explicitly addresses differences between countries with respect to price elasticity of alcohol consumption. Wine producing countries are found to have the least elastic demand for alcohol while both in the monopoly countries (primarily the Scandinavian countries) and the other Nordic countries the demand is more elastic. Interesting the result for the Netherlands is described as unstable with an initially very elastic demand which is less extreme once for a change over time is allowed.

3. Data

The data for the different steps of analysis are drawn from a number of different sources. In order to extra the maximum of possible information we do allow for varying samples in the different part of the report.

3.1. Volume and Value data

For this analysis we used volume and value data provided by the International Wine and Spirit Research (IWSR). IWSR volume data for beer, wine, spirits, and mixed drinks were available from 1994 to 2013 for all EU Member States. Value data for wine, spirits and mixed drinks were available from 2000 to 2013. Unfortunately, data for Belgium and Luxembourg are mingled together in the IWSR source; therefore we exclude these countries in this part of our analysis. The data for the Netherlands are double checked and in the case of beer corrected through the use of national data.

3.2. Tax revenue data

Information on excise duty revenues is from DG TAXUD, the EU Commission. For most EU Member States data was available from 1994 to 2015. For the new EU Member States data is available only from the 2000s onwards. While excise revenue information is available for beer, still and sparkling wine, spirits, and intermediate products, we restrict our analysis to the three main categories of alcoholic beverages in the Netherlands: beer, still wine and spirits. For the Netherlands we also use data for 2014 from national sources.

3.3. Excise tax rates

Excise duty rates for different product categories (beer, still and sparkling wine, spirits, and intermediate products) are taken from DG TAXUD, the EU Commission. Data is available up to February 2015. Since the excise duty rate for different product categories are applied on varying units, e.g. the duty rate for beer is related to degree of alcohol or Plato, the duty rate for spirits drinks refers to litres of pure alcohol, etc., we converted these rates into a single unit and single currency. The underlying assumptions are that beer is at a typical strength of 5 % alcohol, wine at 12 % alcohol and spirits at 40 % vol. alcohol.

4. Intermediate Results

This section first takes a look into intermediate results which will drive the overall results of this study. Specifically, the first step is to identify how much of a tax change is passed on to consumers via higher prices. The second step is to identify how much the volumes sold react to a change in taxation. And the third step directly estimates the reduced form regressions to evaluate how much tax revenues change as a result of reforms of excise taxation on alcoholic beverages. In this context the term reduced form means that we do not attempt to disentangle the tax effect on prices and the price effect on demand and supply, but rather look at the overall impact on revenues. While this does not allow to separately identify the effect of prices and quantities it does give the necessary information for the tax policy reform simulations in the next chapter.

4.1. Price pass-through

The first intermediate analysis in this study is to see how much of the taxes on alcoholic beverages are passed on to consumers in the form of higher prices. This is commonly referred to as price pass-through in the literature. In the case of perfect competition, i.e. a large number of producers and a non-collusive market structure in the distribution one would expect that excise taxes are fully passed on to consumers. Hence the simple theoretical prediction would be a pass-through of unity. However, in market situations where firms possess some market power, a tax increase could result in a so called over shifting, i.e. prices increase by more than the tax increase. In contrast, in competitive market situations, producers and retailers are forced to absorb some of the tax changes. In these cases the pass-through will be less than unity. As a consequence, prices will change less than taxes, therefore the change in consumption should be smaller and the impact of a tax increase on government revenues should increase, in such circumstances.

To estimate the pass-through we use the IWSR data to derive an average price for spirits and wine, and for the different types of spirits separately. The data from IWSR covers most EU countries which allows us to pool the data together first to estimate an overall pass-through for a set of 26 European countries. This has the benefit that we can include a full set of country fixed effects and time fixed effects. Specifically we estimate the following regression

$$p_{it} = \alpha + \beta_1 t_{it} + \mu_i + T_t + \varepsilon_{it} \quad (1)$$

where p_{it} describes the price of the drink and t_{it} the excise tax rate. μ_i and T_t are the country and time fixed effects. The subscripts i and t refer to country and time respectively. The inclusion of these fixed effects allows to control for all effects which are

specific to countries and do not change over time and for all common shocks which are affecting all countries at the same time. The interpretation of the coefficient of interest β_1 also changes. The inclusion of country fixed effects implies that the coefficient can now be interpreted as the effect of a change in the tax rate on the change in the price. A coefficient of 1 therefore means that changes in taxes are fully passed on to prices.

Since the fixed effects regressions constrain the results to one common estimate for all the EU countries included and we are primarily interested in the results for the Netherlands we also run the regression for the Netherlands separately. This does rule out the inclusion of time fixed effects, but instead we include the year Y to capture a linear trend.

(1') $$p_t = \alpha + \beta_1 t_t + Y + \varepsilon_t$$

The results for the regressions (1) and (1') are summarized in Table 2. The second column shows the point estimate and the corresponding standard error and the third column the resulting 95 percent confidence interval. The point estimate gives the estimated price pass-through, i.e. the estimated coefficient for β_1. And the confidence interval indicates how precise the estimate is and can be interpreted as follows. The real underlying pass-through falls into this range with 95 percent probability.

Table 2: Price pass-through different products

Product	Point estimate (standard error)	95 percent confidence interval	Country coverage
Spirits	1.04 (0.05)	0.94 to 1.13	26 European countries
Spirits	0.46 (0.25)	-0.10 to 1.01	Netherlands
Wine	0.09 (0.05)	-0.01 to 0.19	26 European countries
Wine	0.27 (0.50)	-0.83 to 1.39	Netherlands
Genever	0.83 (0.14)	0.56 to 1.11	26 European countries
Genever	0.35 (0.31)	-0.32 to 1.02	Netherlands
Vodka	1.28 (0.05)	1.17 to 1.39	26 European countries
Vodka	1.39 (0.37)	0.57 to 2.21	Netherlands
Bitters	0.71 (0.08)	0.55 to 0.87	26 European countries
Bitters	1.26 (0.70)	-0.27 to 2.81	Netherlands
Gin	1.05 (0.07)	0.93 to 1.19	26 European countries
Gin	0.90 (0.62)	-0.45 to 2.26	Netherlands

Notes: The regressions for the 26 European countries include country and year fixed effects, the regression for the Netherlands a linear time trend.

For spirits overall we find a very tightly estimated pass-through close to unity for the EU countries. For the Netherlands the estimated pass-through of 0.46 is clearly smaller than unity, but also less precisely estimated, so a full pass-through is still in the confidence interval. The less precise estimate is not surprising since a much smaller number of observations will inevitably lead to larger standard errors. For wine the story is rather different, with hardly any pass-through for the EU countries overall and a small and very imprecisely estimated pass-through for the Netherlands. Looking at some of the products in the spirits category separately, one finds a very tightly estimated pass-through close to unity for Gin. For Vodka our results suggest that over shifting is likely while we find an incomplete pass-through for Bitters and Genever. For the latter the difference between the overall estimate and the estimate for the Netherlands is the largest. This is most likely due to the importance of Genever in the Netherlands. At the same time the market for Genever in the Netherlands has been contracting very strongly over the period observed, which may also contribute to the fact that producers and/or retailers are not in a position to fully pass on tax increased onto prices. Overall we find a pass-through close to unity for most products; the one notable exception is wine. Here, however, the picture can also be skewed by the fact that a number of EU countries are not taxing wine at all.

4.2. Reaction of volumes sold to tax changes

The preliminary result established in the previous subsection confirms that prices of alcoholic beverages are affected by the level of taxation. The next step is to investigate whether these price changes lead to changes in the volume sold. Standard economic theory predicts that products with higher prices are consumed less. The strength of the link between prices and consumption is typically measured through the elasticity of demand. The elasticity of demand is the percent change in demand for a product, if the price of the product increases by one percent. While for ordinary products the elasticity of demand is negative, i.e. higher prices lead to less demand, the case might be somewhat different for alcoholic beverages. For addictive substances the demand can become price inelastic. In other words, if consumers are very desperate to obtain alcohol they would accept almost any price. In this case the elasticity of demand would be zero and price changes induced by tax changes will not affect the quantities demanded. This result would imply that taxes can be increased without a reduction in quantities sold. While this would be good news for the revenue raising motive of taxing alcohol, it would render the health aspect or the motive of correcting externalities obsolete.

If, on the other hand, only a minority of consumers is completely addicted to alcoholic beverages and therefore has a completely inelastic demand for alcohol, the overall demand elasticity will still be negative. In the case of a negative elasticity of demand the corrective aspect of taxing alcohol will work, since increasing the tax burden on alcohol will reduce its consumption. On the other hand, a negative elasticity of demand will reduce the capability of tax increases to generate more tax revenues. Therefore the estimated demand elasticities in this subsection are the second relevant intermediate result.

To estimate the demand elasticity one has to overcome a number of obstacles. First, the demand is not observable, but rather the actual quantity sold. This, in turn, is the result of the interplay between demand and supply. Hence simply looking at the impact of price on the volumes sold cannot separate the demand elasticity from the elasticity of supply. Typical approaches to overcome this problem are the use of an instrumental variable approach or the use of some exogeneous variation in the price. For the latter the changes in taxation have been frequently used since the producers cannot easily

influence the tax policy design and therefore treat the tax change as given. We therefore also follow this approach and evaluate the impact of tax changes on the quantities sold. Note that this result will only coincide with the demand elasticity in the case of perfect pass-through. However, from the above intermediate results we know that this assumption is strong, but not completely unrealistic.

To obtain an elasticity we take the logarithm of the quantities sold (v_{it}) and the tax rates (t_{it}). In consequence the estimate for β_1 in regression (2) can now be interpreted as the elasticity. Or in other words, a one percent change in the excise tax (t_{it}) will lead to a β_1 change in the volumes of this product (v_{it}) sold. To control for unobservable time-invariant country characteristics we again include a full set of country fixed effects (μ_i) as well as time dummies (T_t) which capture common shocks. Additionally, we include the logarithm of GDP to control for size and income effects, which yields the regression equation

(2) $$\log(v_{it}) = \alpha + \beta_1 \log(t_{it}) + \beta_2 \log(GDP_{it}) + \mu_i + T_t + \varepsilon_{it}$$

Following the same logic as before, we estimate the regression first for the full EU sample and then run the regression only for the Netherlands. Again, in the regression for the Netherlands only we capture time trends through the inclusion of a linear time trend (Y).

(2') $$\log(v_i) = \alpha + \beta_1 \log(t_t) + \beta_2 \log(GDP_t) + Y + \varepsilon_t$$

The results for spirits, wine and different drinks within the spirits category are summarised in Table 3. The table follows the same logic as before and shows the point estimate for β_1 and the corresponding standard error in the second column and the resulting 95 percent confidence interval in the third column. Note the country coverage in the fourth column is now varying quite a bit since the logarithm zero is not defined and therefore the countries with no taxes on wine are dropped from the regression. In fact, the exclusion of these observations comes at no further costs, since the effect of the absence of taxation would have been captured in the country fixed effects anyway, since all the countries have not taxed wine over the whole period observed.

Starting with the results for spirits Table 3, we find an overall elasticity of -0.25 for the volume of spirits sold. The estimate for the Netherlands is with -0.18 very similar. Both estimates are rather precise and significantly negative. For wine the elasticity for the EU sample is very similar with -0.26. For the Netherlands our results suggest that consumption of wine is more responsive to taxation, with an elasticity of -0.55. Interestingly the results for beer suggest that the volume of beer sold responds positively to increases in taxation. The result is at odds with theoretical predictions. However, for the Netherlands the result is in line with the expectation with a reduction of the beer volumes in response to a tax increase. And somewhat consistent with the inexplicable result (increase) for the full EU sample, the elasticity for beer in the Netherlands is smaller (-0.11) than for the other alcoholic drinks

Table 3: Tax elasticity of volumes for different products

Product	Point estimate (standard error)	95 percent confidence interval	Country coverage
Spirits	-0.25 (0.02)	-0.29 to -0.20	26 European countries
Spirits	-0.18 (0.05)	-0.29 to – 0.07	Netherlands
Wine	-0.26 (0.10)	-0.45 to -0.06	13 European countries
Wine	-0.55 (0.19)	-0.94 to -0.15	Netherlands
Beer	0.06 (0.02)	0.01 to 0.10	26 European countries
Beer	-0.11 (0.05)	-0.22 to -0.00	Netherlands
Genever	1.96 (1.32)	-0.64 to 4.56	15 European countries
Genever	0.02 (0.01)	-0.01 to 0.04	Netherlands
Vodka	-0.20 (0.06)	-0.33 to -0.08	26 European countries
Vodka	-0.00 (0.04)	-0.09 to 0.08	Netherlands
Bitters	-0.14 (0.09)	-0.20 to 0.17	26 European countries
Bitters	-0.07 (0.02)	-0.11 to -0.03	Netherlands
Gin	-0.09 (0.05)	-0.19 to 0.01	26 European countries
Gin	-0.05 (0.06)	-0.16 to 0.07	Netherlands

Notes: The regressions for the European countries include country and year fixed effects, the regression for the Netherlands a linear time trend. Note that for wine the regression contains fewer countries since the logarithm of a zero wine tax is not defined.

A look at the different product within the spirits category reveals quite some variation which might be due to very different consumption patterns across the countries. An alternative explanation is that large drink producers pass on taxes to a varying degree, which is also visible to some extent in the previous results in Table 2. In consequence the changes of taxes are not fully reflected in the prices and therefore the widely varying results for the different subcategories in Table 3 can at least partly explained. However, please note, these results – especially those for the Netherlands – are by and large not statistically significant because of a large standard errors as a result of the small sample size. In sum we find the expected negative elasticity for spirits and wine, while for beer or for specific subgroups of spirits the evidence is mixed.

4.3. Reaction of tax revenues to tax changes

The results so far suggest that taxes are at least to some degree passed on to prices and that, in consequence, tax increases lead to reduced consumption. Therefore the next step in this subsection will be to see how this translates into tax revenue effects of tax changes. A tax increase will have the direct positive mechanical effect on tax revenues that the quantities consumed are now taxed at a higher rate. If the taxes are not passed on to prices at all or if the demand is completely inelastic the quantity sold will not react and this mechanical effect will be the only result of a tax change. In this simple case the coefficient will be exactly 1. In reality, however, tax increases will – as shown in the two previous subsections - most likely increase prices and thereby reduce consumption/sales. This has a negative effect on tax revenues. The overall impact of a tax change on tax revenue can be positive or negative, depending on the size of the decline in sales. Specifically if the tax elasticity of demand is larger than -1 the overall tax revenue effect of a tax increase will be negative. This result has been discussed in the literature extensively as the prohibitive side of the Laffer curve (See e.g. Wanniski, 1978 and Laffer, 2004). In the case of alcoholic beverages the results of the previous subsections suggest that the overall effect of a tax increase should lie between zero and unity.

4.3.1. Direct revenues effects

First we only analyse the direct tax revenue effects of a change in the tax rates. To this end we regress the collected tax revenues for spirits, wine and beer (r_{it}) on the respective tax rate (t_{it}). In line with previous regressions we again control for country size and income through GDP and include country and time fixed effects. This results in the following regression equation.

(3) $$\log(r_{it}) = \alpha + \beta_1 \log(t_{it}) + \beta_2 \log(GDP_{it}) + \mu_i + T_t + \varepsilon_{it}$$

Again, we run the regression first for all available EU countries and then for the Netherlands only. In the regression for the Netherlands we capture time trends through the inclusion of a linear time trend (Y).

(3') $$\log(r_i) = \alpha + \beta_1 \log(t_t) + \beta_2 \log(GDP_t) + Y + \varepsilon_t$$

Table 4 shows the result for three main product groups. The tax revenue elasticity of spirits is 0.52 for the EU country sample. The corresponding result for the Netherlands is 0.56, implying that a one percent increase in the tax burden on spirits in the Netherlands should increase the corresponding tax revenues by about 0.56 percent. Despite the smaller number of observations this estimate is relatively precise with a standard error of 0.17 resulting in 95 percent confidence interval ranging from 0.20 to 0.92.

The tax revenue elasticity estimate for wine is around 0.60 for both the EU sample and the Netherlands. This elasticity is very similar to the one for spirits, albeit a bit less precisely estimated. In contrast, the tax revenue elasticity for beer is around 0.8 for both the EU sample and the Netherlands with clearly smaller standard error. This implies that a 1 percent increase in tax rates for beer will translate into a 0.8 percent increase in tax revenues. This elasticity is clearly higher than the ones for both spirits and wine and broadly in line with the result from the previous subsection that the tax changes result in no strong change of consumption for beer. Note that the result from the previous subsection would even indicate a tax revenue elasticity above unity. The result in Table

4, in contrast, seems more plausible, but might be subject to change once more when the substitution effects are taken into account.

Table 4: Tax elasticity of revenues for different products

Product	Point estimate (standard error)	95 percent confidence interval	Country coverage
Spirits	0.52 (0.06)	0.41 to 0.63	26 European countries
Spirits	0.56 (0.17)	0.20 to 0.92	Netherlands
Wine	0.60 (0.11)	0.39 to 0.81	13 European countries
Wine	0.59 (0.21)	0.12 to 1.06	Netherlands
Beer	0.82 (0.05)	0.72 to 0.91	26 European countries
Beer	0.78 (0.07)	0.63 to 0.93	Netherlands

Notes: All regressions also include the logarithm of GDP to control for changes in the country size. The regressions for the European countries include country and year fixed effects, the regression for the Netherlands a linear time trend. Note that for wine the regression contains fewer countries since the logarithm of a zero wine tax is not defined.

4.3.2. Direct and substitution effects

The consumption of spirits, beer and wine is most likely not independent from each other. Hence we will allow for substitution effects between different drinks in this subsection. Specifically we include the tax burden of the other types of alcoholic beverages ($k \neq j, l \neq j$) in the regression as additional explanatory variables. This implies that for the regression on the tax revenues for spirits, we include not only the tax burden on spirits, but also tax burden on wine and beer.

$$(4) \quad \log(r_{it}^{j}) = \alpha + \beta_1 \log(t_{it}^{j}) + \beta_2 \log(t_{it}^{k \neq j}) + \beta_3 \log(t_{it}^{l \neq j}) + \beta_4 \log(GDP_{it}) + \mu_i + T_t + \varepsilon_{it}$$

Again, we run the regression first for all available European countries and then for the Netherlands only. In the regression for the Netherlands we capture time trends through the inclusion of a linear time trend (Y).

$$(4') \quad \log(r_{t}^{j}) = \alpha + \beta_1 \log(t_{t}^{j}) + \beta_2 \log(t_{t}^{k \neq j}) + \beta_3 \log(t_{t}^{l \neq j}) + \beta_4 \log(GDP_{t}) + Y + \varepsilon_{t}$$

Table 5 summarises the results of the regressions including the substitution effects between the different alcoholic beverages. The main diagonal is the own tax elasticity and describes the effect of a one percent change on the corresponding tax revenues. The off diagonal entries show the substitution effects. Positive entries here imply that a higher tax rate on one alcoholic beverage increase the tax revenue for another type of drink. The underlying mechanism here is the substitution between different types of alcoholic drinks. If the prices of one product category are increased as a result of taxation, the consumers consume less of this product and substitute with other alcoholic beverages, which in turn results in a positive effect on the tax revenues there. Negative entries would indicate that two products are complements, i.e. that they are usually

consumed together. In this case, a higher tax burden and higher price will reduce not only the consumption of the good taxed, but also the consumption of the complementing good. For expositional reasons we only report the point estimates and the corresponding standard errors. The interested reader can calculate the resulting 95 percent confidence interval by adding and subtracting 1.96 times the standard error to the point estimates.

Starting with the results for 13 European countries (the other 14 countries are dropped because they have zero taxation on wine) one can see that the tax elasticity of revenues is now somewhat higher and still highest for beer. For spirits the tax elasticity of revenues is now 0.69 compared to 0.52 in Table 4, where the substitution effects are omitted. Moving down the first column one can see that the tax revenues from the taxation of spirits are barely depending on the taxation of wine, and that beer seems to be a complement for spirits. However, the latter result is not very precisely estimated and therefore barely significant. Moving along the first line one can see that the taxation of spirits has a positive impact on the tax revenues of wine taxes and no effect on the revenues from beer taxation. Looking at wine on can see an own tax elasticity of revenues of 0.63 which is again somewhat higher than in Table 4. Beer now has a tax elasticity of revenues of 1.04. This coefficient above 1 would imply that increasing beer taxation would increase revenues more than proportionally, which is in line with the positive coefficients for the volume sold in Table 3. While this exact result is surprising and should be taken with a pinch of salt, the tendency is consistent and clear. A tax change for beer results in a stronger tax revenue effect than for wine or spirits. Interestingly the results for both beer and wine suggest that these two types of products are complementary.

Table 5: Tax elasticity of revenues for different products with substitution effects

Results for 13 European countries			
	Spirits	Wine	Beer
Spirits	0.69 (0.07)	0.28 (0.10)	0.00 (0.05)
Wine	0.03 (0.09)	0.63 (0.12)	-0.34 (0.06)
Beer	-0.20 (0.08)	-0.26 (0.11)	1.04 (0.06)
Results for the Netherlands only			
Spirits	Spirits	Wine	Beer
Spirits	0.48 (0.18)	0.00 (0.17)	0.18 (0.07)
Wine	0.32 (0.27)	0.62 (0.25)	-0.05 (0.11)
Beer	-0.14 (0.19)	-0.13 (0.23)	0.78 (0.09)

Notes: All regressions also include the logarithm of GDP to control for changes in the country size. The regressions for the European countries include country and year fixed effects, the regression for the Netherlands a linear time trend. Note that for wine the regression contains fewer countries since the logarithm of a zero wine tax is not defined.

The lower half of Table 5 looks at the own tax elasticity and the substitution effects for the Netherlands only. The results for the own tax elasticity of revenues are broadly in line with the results in Table 4 and are somewhat lower than for the average of the

European countries. For example for spirits a one percent tax increase is only estimated to result in a 0.48 percent increase in tax revenues. This is somewhat below the estimate for the sample of 13 European countries. The own elasticity for the taxation of wine is higher with a coefficient of 0.62. Again for beer the tax revenue elasticity is highest with a value of 0.78. This is however, significantly below 1 indicating that for the Netherlands only the consumption of beer is not positively reacting to tax increases.

With regards to the substitution effects, the complementarities between beer and other alcoholic beverages are also found. But in contrast to the results for the 13 European countries the substitution effects between spirits and other alcoholic beverages are different. There seems to be a positive contribution of the taxation of wine to the tax revenues from spirits and a higher taxation of spirits now contributes to more tax revenues from beer.

4.3.3. Cross-border shopping

Yet another way of substitution is the possibility to buy the products abroad. If there are relevant differences in the level of taxation it can pay off to buy the products in the neighbouring countries. If the extent of cross-border shopping is large enough, revenues from taxing alcohol will not only depend on the own tax rate but also on the corresponding tax rate in the neighbouring countries. Therefore one more specification investigates the impact that the taxation of spirits has on the neighbouring tax revenues. Specifically we look at two neighbouring countries c, Belgium and Germany, which yields the regression equation

$$\log(r_t^c) = \alpha + \beta_1 \log(t_t^c) + \beta_2 \log(t_t^{NL}) + \beta_3 \log(GDP_t) + Y + \varepsilon_t \quad (5)$$

In principle one could look at the same phenomenon by analysing the impact of the German or Belgium tax rate in the Netherlands. This effect is however less well identified since the German tax rate for spirits has not been changed over the last 15 years. This also results in a very imprecise estimate for the direct effect of the German tax rate on the German tax revenues. Therefore Table 6 only reports the effect of the Dutch tax rate on spirits on the tax revenues from taxing spirits in neighbouring countries.

Table 6: Tax revenue effects in selected neighbouring countries

Neighbour	Point estimate (standard error)	95 percent confidence interval	Magnitude for tax revenues in neighbouring country
Germany	0.10 (0.13)	-0.18 to 0.38	2,182 million Euros
Belgium	0.26 (0.11)	0.02 to 0.49	220 million Euros

Notes: All regressions also include the logarithm of GDP to control for changes in the country size, the own tax rate on spirits and a linear time trend.

For Germany the estimated elasticity is 0.10 but the confidence interval is too broad for the effect to be statistically significant. In contrast, for Belgium that applies a similar duty rate on spirits and recently set it even above the rate of the Netherlands, one can see a significantly positive effect of 0.26. The last column in Table 6 reports one potential reason for the difference in the outcome. In the large country Germany an increase in

the sales of spirits due to increased cross-border shopping by Dutch consumers will be less visible. In contrast, in a small country like Belgium the effect of cross-border shoppers is more relevant. Overall, however, it can be concluded that the numbers are consistent with a story of cross-border shopping, but that evidence is weak due to data limitations.

5. Simulation of tax changes

In this subsection we use the estimated elasticities to simulate how changes in the taxation of alcoholic beverages will affect tax revenues. After defining the benchmark, i.e. the values we compare the outcome of the simulated tax change to, three main scenarios are investigated. First how would the tax burden look like, if we were to change the tax rates in way that holds the overall tax revenues roughly constant but taxes the alcohol content of all products at the same rate? Second, what are revenue neutral scenarios that would reduce spirits excise duty rates by 10%? And finally, we assume revenue raising motive/scenario and simulates which tax increases would be necessary to raise 100 million Euros extra.

5.1. Defining the benchmark for the simulation

Before we set out look at different scenarios for tax changes it is useful to define the benchmark. Starting point is the current tax burden of the alcohol content which differs substantially for the different products. In Table 7 we summarise this situation and also include the prediction for 2015.

Table 7: Benchmark for simulation exercise

Alcoholic beverage	Revenues (in Mio Euros)	Volume (in 1,000 hl)	Tax rate per hl pure alcohol (in Euros)
2013 (observed values)			
Spirits	321	636	1,594
Wine	317	3,904	760
Beer	406	11,691	718
Sum	1,044	16,231	
2014 (observed values/predictions in italics)			
Spirits	311	*614*	1,686
Wine	330	*4,356*	804
Beer	423	*11,559*	760
Sum	1,064	*16,529*	
2015 (observed values/predictions in italics)			
Spirits	*324*	*606*	1,686
Wine	*349*	*4,428*	804
Beer	*430*	*11,469*	760
Sum	*1,103*	*16,503*	

Notes: All regressions for the predictions also include the logarithm of GDP to control for changes in the country size and a linear time trend.

Currently the tax on pure alcohol per hl is at 1,686 for spirits. In contrast for wine it is around 804 Euros and for beer it is at 760 Euros. Together the total revenues from these three products amounted to 1,064 million Euros in 2014. Under the current tax regime we expect the volumes for spirits and beer to continue to decline. At the same time we predict the revenues to slightly increase for all products. These two results are at least in its direct interpretation contradictory and this is due to the fact that the tax revenues and the volume sold are predicted from two distinct regressions. This implies that the contribution of GDP and the linear time trend are different for the tax revenues and the volumes sold. While this could only be purely a statistical artefact, it could also reflect that over time the effectively raised tax has increased. This could be due to differences in the strength of the products sold or due to more stringent tax administration. Furthermore, it is important to bear in mind, that the simulations are based on the regressions for the Netherlands only. This implies that some of the underlying parameters are only estimated imprecisely and are not statistically significant. We still prefer to use the Netherlands only regression over the statistically more significant fixed effects regression since they are explaining a larger share of the variation and therefore provide a more plausible forecast.

5.2. Equal tax burden on all products

First we look at a scenario which holds the total tax revenues roughly constant, but changes the tax burden of the different products in such a manner that the alcohol content is taxed at a similar rate.

Table 8: Results for simulation of equal tax burdens

Alcoholic beverage	Revenues (in Mio Euros)	Volume (in 1,000 hl)	Tax rate per hl pure alcohol (in Euros)
2015: Benchmark			
Spirits	*324*	*606*	1,686
Wine	*349*	*4,428*	804
Beer	*430*	*11,469*	760
Sum	*1,103*	*16,503*	
2015: Equal tax burdens			
Spirits	*263*	*664*	1,012
Wine	*387*	*3,607*	1,005
Beer	*475*	*11,206*	987
Sum	*1,125*	*15,477*	

Notes: All regressions for the predictions also include the logarithm of GDP to control for changes in the country size and a linear time trend.

Starting from the benchmark for 2015 described in the previous subsection and shown in the lower part of Table 7 we adjust the tax burden to a roughly equal tax burden for all three products. To this end we lower the tax burden on spirits and raise those for beer and wine to end up with a roughly equal overall amount of tax revenues. Specifically we model the following: The tax burden for ethyl alcohol is lowered by 40 percent to 1,012 Euro per hl of pure alcohol. The tax rate for beer is increased by 30 percent to a level of 987 Euro per hl of pure alcohol and the rate for still wine is increased by 25 percent to 1,005 Euro per hl of pure alcohol.

Table 8 summarizes the simulation results for this scenario. For ease of comparison we also include the benchmark prediction for 2015. The above described tax reform will result in an almost unchanged overall tax revenue of 1,125 million Euros. However, due to the drastic tax rate reduction spirits now only contribute 263 million Euros. At the same time the reduction of the tax burden would increase the volumes sold to 663,955 hl. In contrast for wine the volume sold will reduce substantially from 4.4 million hl to 3.6 million hl. This sharp reduction in the quantity sold results in an only moderate increase in tax revenues from 349 million Euros to 387 million Euros. For beer our simulation suggests an increase of tax revenues to 475 million Euros. At the same time the volume sold is predicted to decrease to 11.2 million hl. This reduction dampens the additional revenue effects from the beer taxation.

5.3. A revenue neutral reduction of 10 percent on spirits

The second scenario we want to consider is a revenue neutral reduction of the tax burden on spirits. Reducing the tax burden of spirits by ten percent would lower the tax burden to 1,517 Euro per hl pure alcohol. To have a revenue neutral tax reduction we consider three ways to finance the tax reduction on spirits. First we increase both the tax on beer and wine at the same proportion. Second we increase only the tax burden on wine, and finally only the tax burden on beer. Table 9 summarizes the results, where the top of the table once more includes the benchmark for comparison.

Table 9: Results for simulation of a revenue neutral tax reduction for spirits

Alcoholic beverage	Revenues (in Mio Euros)	Volume (in 1,000 hl)	Tax rate per hl pure alcohol (in Euros)
2015: Benchmark			
Spirits	*324*	*606*	1,686
Wine	*349*	*4,428*	804
Beer	*430*	*11,469*	760
Sum	*1,103*	*16,503*	
2015: Equal tax increase on wine and beer			
Spirits	*310*	*617*	1,517
Wine	*357*	*3,967*	843
Beer	*436*	*11,474*	797
Sum	*1,104*	*16,059*	
2015: Tax increase on wine only			
Spirits	*317*	*617*	1,517
Wine	*368*	*3,607*	876
Beer	*419*	*11,537*	760
Sum	*1,104*	*16,040*	
2015: Tax increase on beer only			
Spirits	*303*	*617*	1,517
Wine	*343*	*4,074*	804
Beer	*457*	*11,404*	842
Sum	*1,104*	*16,095*	

Notes: All regressions for the predictions also include the logarithm of GDP to control for changes in the country size and a linear time trend.

The second block looks at the scenario where both the tax burden on wine and beer are increased by five percent to 843 respectively 797 Euros per hl pure alcohol. This would result in an almost unchanged sum of tax revenues of 1,104 million Euros. The volumes of spirits sold would moderately increase to 617,191 hl, while the tax revenues from spirits would drop to 310 million Euros. The increase in the revenues from wine and beer however would be sufficient to compensate this reduction.

The lower part of Table 9 shows the revenue neutral reduction for spirits if the tax burden is only increased on one of the other drinks. Our simulation suggests that for wine a 9 percent increase to 876 Euros per hl pure alcohol is necessary to compensate for the ten percent reduction. The smaller necessary increase is due to the substitution effect to spirits. In contrast, if one were to only increase the tax burden on beer, one would need an 11 percent increase to 842 Euros per hl pure alcohol. This is due to our result which suggests that beer is a complementary good to both wine and spirits. Hence an increase in the taxation of beer alone would according to our simulation also reduce the consumption of wine and spirits.

5.4. How much tax increase is needed for an extra 100 Mio Euros

As a third scenario we investigate how tax rates need to be set to increase the tax revenues from alcoholic beverages by 100 million Euros. First we investigate how much the tax rate on each beverage type needs to be increased and finally we look at a proportional increase. Table 10 first repeats the benchmark prediction and then the simulations for each tax reform in turn. The necessary increase for spirits would be a 49 percent increase up to 2,512 Euros per hl pure alcohol. This would still only result in about 70 million Euros extra in revenues. However due to the substitution effect the tax revenues from beer would increase also around 30 million Euros. In the case of a tax increase for wine only, one would need to increase the tax burden by 36 percent to 1,093 Euro per hl pure alcohol. This would decrease the quantity of wine sold substantially and only increase the revenues from wine by a bit more than 70 million Euros. However, the substitution effect to spirits would once more create the additional 30 million revenues. A tax reform purely on beer would need to raise the tax burden on beer by 41 percent to 1,072 Euro per hl alcohol. This would raise the additional extra revenues and even compensate for small reductions in the revenues from the taxation of wine and spirits because of the complementary nature of beer.

Finally for a proportional increase in the tax burden a 13 percent increase would be necessary to raise the additional 100 million Euros. This amounts to a tax increase to 1,905 Euros for spirits, 909 for wine and 859 for beer. According to our simulation this would increase the tax revenues from the taxation of beer by about 50 million Euros. And the rest would come from spirits and wine which see a much stronger reduction in the consumption.

One further thing which needs to be considered in any of these tax simulations is the fact, that any change in volumes sold will not only result in a change in excise tax revenues but also will affect the revenues from value added tax (VAT). It is rather difficult to exactly predict the extent of VAT revenue losses due to reduced consumption, but the reported retail value from the IWSR allow at least for an approximation. The retail value for spirits overall imply an average retail price of 18.8 Euros per litre. At the current rate of VAT of 21 % this implies that for every litre of spirits not sold an amount of almost 4 Euros in VAT revenues is foregone. Multiplying this with the reduction of approximately 43,000 hl in the first scenario, this would mean that raising 100 Mio. Euros through raising the excise tax burden on spirits only would reduce the VAT revenues by roughly

17.2 Mio. Euros. Despite the fact that this is only a very rough approximation, and the counteracting VAT effects because of the increase consumption in wine, this highlights the difficulties of raising a large amount of tax revenues from only one – already highly taxed – commodity.

Table 10: Results for simulation of necessary tax increase to raise 100 Mio. Euro extra

Alcoholic beverage	Revenues (in Mio Euros)	Volume (in 1,000 hl)	Tax rate per hl pure alcohol (in Euros)
2015: Benchmark			
Spirits	*324*	*606*	1,686
Wine	*349*	*4,428*	804
Beer	*430*	*11,598*	760
Sum	*1,103*	*16,632*	
2015: Only increase in tax rate on spirits			
Spirits	*391*	*563*	*2,512*
Wine	*349*	*4,074*	*804*
Beer	*461*	*11,537*	*760*
Sum	*1,201*	*16,174*	
2015: Only increase in tax rate on wine			
Spirits	*358*	*606*	*1,686*
Wine	*423*	*3,444*	*1,093*
Beer	*422*	*11,537*	*760*
Sum	*1,203*	*15,587*	
2015: Only increase in tax rate on beer			
Spirits	*308*	*606*	*1,686*
Wine	*333*	*4,074*	*804*
Beer	*562*	*11,107*	*1,072*
Sum	*1,203*	*15,787*	
2015: Proportional increase			
Spirits	*351*	*592*	*1,905*
Wine	*371*	*3,811*	*909*
Beer	*480*	*11,382*	*859*
Sum	*1,202*	*15,784*	

Notes: All regressions for the predictions also include the logarithm of GDP to control for changes in the country size and a linear time trend.

6. Concluding Remarks

This study takes an in-depth look at the taxation of alcoholic beverages in Europe in general and particularly investigates the excise taxes in the Netherlands. Starting from the observation that in the Netherlands excise tax rates for different types of alcoholic beverages are varying substantially and have also been increased significantly over the

last two decades, the impression arises that alcohol is not only taxed to curb excessive behaviour, but also with a tax revenue motive in mind.

Two intermediate results show that excise taxes are likely to be passed on fully to prices and that the volume sold reduces as a result of higher taxation. This confirms that taxing alcoholic products has the potential to contribute to a reduction of excessive consumption, but also that raising tax revenues can be increasingly difficult for a higher tax burden.

The direct regressions confirm that excise tax increases for spirits will results in a clearly less than proportional increase in tax revenues. The implied erosion of the tax base will be the strongest for spirits and much less pronounced for beer. Part of the reduced consumption can be attributed to a substitution to other alcoholic drinks and some indirect evidence also suggests that neighbouring countries will profit through increased cross-border shopping.

Using the regression results for simulating tax changes it is found that increasing tax revenues from excise taxes on spirits needs a stronger increase that for other alcoholic beverages. Furthermore the knock-on effect through VAT revenues forgone may well further counteract the revenue raising motive.

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